Annex 2: Sample Engineering Considerations and Instructions for Field Personnel (ECIFP)

B2-1. Sample ECIFP

The following is a sample ECIFP. The ECIFP must be tailored specifically for the individual project plans, specs, and field situation. Some of the considerations in this example may not be appropriate for another project. The ECIFP should not repeat the specification requirements, but should highlight only specific items needing additional discussion beyond the specification wording or what is shown on the plans. ECIFP's must not contain information in conflict with the specifications.

a. General. Both Army and the Corps of Engineers consider quality to be top priority for pavements. This is especially true considering that a single defect in an airfield pavement can cause extraordinarily expensive repairs and even complete loss of an aircraft. These special design considerations pertain to all work in the contract involving the concrete pavement and joint sealing. Pertinent specification sections are xxxxx, xxxxx, and xxxxx. These design considerations also refer to pavement joint layout and joint details shown on the drawings.

b. Pavement workshop. A short concrete pavement workshop at the project office is recommended early in construction to provide information on a variety of concrete pavement construction topics, and as an opportunity to discuss in detail the plans and specifications with designers and with the Contractor, and to discuss Contractor proposals. The workshop can be conducted by the design office and the TSMCX, with the construction office.

c. Material and equipment submittals (para. x in xxxxx). The Government must complete certain tests and reviews for this project prior to construction. The specifications list the submittal and timing requirements:

(1) Materials testing. Aggregates, cement, pozzolan, and admixtures are sent to the xxxxxxxxxxx Lab. Shipping is at Contractor expense, testing is at Government expense. These materials are tested to assure the materials can produce acceptable concrete, and to provide mix proportions for the Contractor's use at their option or for a check mixture testing of the contractor mixture proportions. Contact xxxxx xxxxx at xxxxxxx Lab (xxx) xxx-xxxx.

(2) Mixture proportioning. The selection of mix proportions for construction is the Contractor's responsibility. Make sure the Contractor follows the specification requirements for mix proportioning procedures, as they often forget to proportion the required number of mixtures and run all of the tests, resulting in project delays. The concrete specimens for mixture proportioning strength testing must be cast at the maximum permitted slump and air content.

(3) Joint sealant and lubricant samples are sent to Waterways Experiment Station, Vicksburg, MS. Contact CEWES for more information prior to sending.

(4) Mixing plant and paver. The Contractor should submit information on the mixing plant and paver proposed for use as soon as possible, since this submittal often doesn't initially meet the specification requirements. This is a critical submittal for it directly affects the quality of the project. The paver requirements have been carefully prepared to avoid use of pavers that have not performed adequately on previous similar work. Any paver submitted for use must be carefully checked against the specification.

d. Concrete strength (para. x in xxxxx). These paragraphs spell out all of the flexural and other strength requirements. Tests at 1 (accelerated splitting tensile test), 14, and 28 days are required for early information. By comparing strengths at early ages with laboratory curves, the contractor can get an indication of the strength potential at 90 days.

e. Slump (para. x in xxxxx). The slump limits in the specification are maximums, <u>not</u> averages. The slump limit for slipform paving is especially critical for acceptable pavement construction. Concrete which has a slump over these limits must be rejected.

f. Air entrainment. Air content is a critical parameter for frost areas. Air content below the required limits will result in non-durable concrete. Air content above the required limits will reduce strength.

g. Materials (para. x in xxxxx).

(1) Aggregates must meet special grading requirements and special limits on deleterious materials. Deleterious material limits are essential to avoid popouts and other durability problems caused by weak aggregate particles. These have been a serious problem on a number of pavements across the nation. Excessive wood chips can also be a problem with some local aggregates, and must be removed.

(2) Cement and Class F or C Pozzolan. Pozzolan provides many benefits in concrete, but must be carefully evaluated to avoid occasional problems. The source of pozzolan is an important indicator of its performance. Contact the materials engineer for more information on sources.

(3) Admixtures. Note that retarding admixtures are not permitted for slipform paving, but are allowed for fixed-form paving. Retarders are useful in hot weather to provide extra finishing time, but cause excessive edge slump in slipform placements. Any admixture used in the concrete construction must have been the same specific admixture used in the mixture proportioning studies.

h. Forms and stringline (para. x in xxxxx). The stringline, used to control the surface alignment of each lane, is crucial to a successful job. The stringline should be used by the Contractor to check the grade prior to each lane placement. A large portion of one airfield apron was recently removed due to inadequate thickness when these checks weren't made.

i. Batching and mixing of concrete (para. x in xxxxx). Because of the high concrete production necessary for this project, and the low slump concrete required, an on-site central mix concrete plant is required. No transit mixers may be used. The recorder data should be checked daily to assure that the Contractor is batching materials properly. Improper batch weights is a common problem that has led to inadequate pavement strengths. The Contractor must perform periodic mixer efficiency tests. Inspectors should become very familiar with the plant, how it is operated and how each part should function. Plant calibration should be monitored closely, particularly if load cells are used instead of visible weigh scales.

j. Placing (para. x in xxxxx). A few early cores for thickness can be used to insure that the paver is properly consolidating the concrete by observing the cores for voids or segregation.

k. Finishing (para. x in xxxxx). A concrete pavement does not require much finishing. If the paver is working well finishers should hardly have to touch the pavement surface. Finishing with cutting straightedges should be almost all that is required. Do not permit finishers to add water to the surface! Also do not let finishers build up edges that have slumped by adding mortar or concrete. While the concrete is still plastic, a straightedge should be laid longitudinally and transversely in the lane to assure surface smoothness of the hardened concrete will be acceptable.

l. Curing (para. x in xxxxx). Adequate concrete curing is essential for strength gain and for a durable pavement surface. White pigmented membrane curing compound must be applied as soon as the texturing is completed. Application rate should be checked each shift by placing 1 foot square pieces of cardboard on the pavement surface, and removing them after the curing machine has passed by. By weighing the cardboard before and after application, the amount put down can be calculated. This can be checked by determining the total quantity sprayed during each shift. Properly applied curing compound will appear as a continuous white film with no concrete showing through.

m. Surface tests (para. x in xxxxx). For slipform construction, particular attention should be paid to lane edges where edge slump can occur. Straightedge testing must be completed no later than 36 hours after placement. For assistance with Profileograph measurement issues, contact the design office or the TSMCX.

n. Pavement thickness tolerance (para. x in xxxxx). Pavement load capacity is heavily

dependent on thickness. The pavement thickness must be checked within 7 days of placement by drilling cores. When deficient areas are discovered, additional cores must be drilled to better define the extent of the deficiency.

o. Repair and replacement (para. x in xxxxx). Completed pavement should be carefully inspected for cracks and spalls. Any necessary repairs must be completed before acceptance. Slabs which are irreparable, too thin, or have excessive edge slump, must be removed and replaced.

p. Joints (para. x in xxxxx). Many pavement failures occur at joints, making these a critical feature of successful concrete pavement. Joints allow temperature and shrinkage movement in the concrete, while providing load transfer. Joint details shown in the drawings are not trivial and construction should follow these details precisely. Location or type of joints as shown on the drawings must not be altered without written approval of the designer.

(1) Longitudinal construction joint. Where keyways are used, dimensions of the keyway are crucial to assure adequate load transfer across the joint, and any areas which do not match the detail must be doweled for a minimum of one slab length. Dowels are covered below.

(2) Transverse construction joint. This joint is most commonly used for the end of a work day. This joint must be doweled (keyways are not acceptable) and it must be constructed at the location of a planned transverse joint.

(3) Longitudinal contraction joint. This joint is used down the middle (for example) of a paved strip to break it into two lanes. This joint must be sawed.

(4) Transverse contraction joint. This joint must be sawed for slipformed pavements.

(5) Expansion joint. This joint is located in new pavement at changes in pavement direction and around fixed structures, to accomodate temperature and shrinkage movement by isolating the pavement sections. The expansion joint material must be placed full depth for the joint to be effective.

(6) Special expansion joint. This joint is located between new and existing pavements, to provide load transfer and accomodate temperature and shrinkage movement. This joint is difficult to construct properly, and requires extra vigilance.

(7) Joint sawing. Joint sawing timing is difficult to predict, but is critical to anticipate to avoid widespread cracking. 4 to 24 hours after placement is generally the proper time frame, depending on temperature and humidity. This frequently means working in the middle of the

night. Especially at the beginning of the job, all sawing should be closely inspected while it is taking place to make sure sawing is done at the proper time and location. The first placement is frequently where contractors either saw too late to avoid cracking, saw too early and cause excessive spalling, or saw at the wrong locations. All are very obvious problems, and impossible to adequately correct once they occur.

After initial sawing is completed, a rope must be placed in the top of the joint to assure it doesn't fill up with debris, and to provide additional curing in the critical joint area. Curing of this area is critical to avoid joint spalling which has been occurring with increasing frequency on recent concrete pavements.

(8) Dowels. Dowel installation and alignment is a recurring problem in concrete pavement construction. When installing dowels in drilled holes "buttering" of dowels with epoxy (which many contractors will propose doing) and then pushing them in the drilled hole does not provide adequate dowel strength. Epoxy must be injected into the rear of the hole, followed by dowel insertion by a twisting action. Dowels must be installed straight and level to perform adequately. Misaligned dowels will "lock" the joint and not allow temperature and shrinkage movement.

q. Joint preparation for sealant (para. x in xxxxx). Premature joint sealant failure is a not uncommon problem with concrete pavements. Joints must have proper dimensions and must be prepared correctly to insure adequate performance. Regardless of how a joint was originally constructed, the slot for sealant must be sawed out. Sealant will adhere adequately only to joints with vertical sides and clean faces. Sandblasting is required to assure all laitance, curing compound, and debris is removed. All joints should be inspected and measured carefully before sealant is installed. For hot poured sealants, sealant temperature when installed is critical for proper performance, and should be monitored closely by the contractor.

r. Measurement and payment (para. x in xxxxx). This project has been designed to be bid on a unit price basis, so it is extremely important that accurate accounting is done for proper payment. Concrete is to be measured by the cubic yard (cubic meter) according to the dimensions shown on the drawings. This is not necessarily the same as the number of cubic yards (cubic meters) of concrete delivered to the site.

Paragraph x in xxxxx contains a reduction-in-pay clause for thickness deficiency. This clause has been added to motivate the Contractor to produce quality work. It is not intended to be a crutch or an excuse for building a sub-standard pavement.

s. Contractor quality control (CQC) (para. x in xxxxx). CQC in a paving job should be more rigorous than in other kinds of construction. The QC Lab must be an independent lab which has recently been inspected by a Corps laboratory. All Government and QC staff testing concrete

must be ACI certified as Concrete Field Testing Technicians Grade I, or Concrete Laboratory Testing Technicians Grade I or II..

(1) Concrete strength. Strength data should always be immediately reviewed and can be analysed at the construction office, or can be sent to the design office for analysis and rapid feedback to the construction office.

(2) Aggregate tests. Deleterious materials are particles of aggregate which even at relatively low percentages can have an adverse effect on the strength and durability of the pavement. These tests are essential. Only the specific deleterious material test(s) that pertain to the aggregate(s) being used need to be tested at the frequency specified. Deleterious material testing frequency must be closely followed, and may be reduced as specified after initial test results are consistently within required limits. QC and QA testing laboratories should be briefed on the importance and specific tests required for deleterious materials compliance.

(3) Slump and air content. Slump and air content (particularly in frost regions) must be checked at the stipulated intervals, but also any time a concrete batch looks suspect.

(4) Test result actions. All of the QC test results must be recorded on control charts which must be turned in to the Government each day. When any individual tests indicate materials or work exceed specification limits, specific action is required, including doubling the testing frequency or stopping work.

t. Mandatory government quality assurance. If government manpower is short, a separate commercial lab should be contracted for QA testing, using ACI certified Field Testing Technicians Grade I or Certified Laboratory Technicians Grade I or II. At the beginning of the job, QA testing frequency should nearly match that of QC testing. After initial QA testing demonstrates the adequacy of the QC program, QA testing can be scaled back to a rate meeting ER 1180-1-6, “Construction Quality Management.” Preparatory inspections just prior to each concrete pavement placement should be well documented for use if later problems develop.

u. Project staffing. Proper inspection of a paving job of this magnitude requires at least two (three is better) experienced full-time Quality Assurance Representatives (QAR). One to monitor production at the plant and one to monitor placement at the paver. These QAR should be assisted by adequate office staff to process paperwork. A high priority should be put on keeping the project adequately staffed.

v. District field support. The design office has a keen interest in concrete pavement construction support. Personnel experienced in concrete paving are available to answer field questions and to assist in the field inspection, to conduct a pre-construction paving workshop for

field personnel, and are available to participate in a preconstruction meeting with the Contractor. The services of an experienced geotechnical/pavement engineer is recommended to assist you during the concrete pavement construction as required. The TSMCX is available to provide paving workshops, to respond to construction inquiries, and to locate additional resources for construction assistance. The resident office is encouraged to contact the design office at (xxx) xxx-xxxx and the TSMCX before paving begins and as it progresses.

w. Post-construction data transmittal. The construction office should send a copy of all QA and QC tests results to the design office soon after testing is completed. This data is essential for use on subsequent projects. Data transmittal during construction is also encouraged in order to provide current statistical analysis of field data, particularly strength, according to ACI 214. This kind of analysis can be a significant contribution to the construction process by providing immediate feedback not only on strength performance, but also the quality of testing performed.